

STUDIES ON HIGH ALTITUDE SAXICOLOUS CYANOPHYTA

X. On the morphology of *Coleodesmium wrangelii* (Ag.) Borzi and *Coleodesmiumopsis* gen. nov.

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ABSTRACT. — The present paper deals with the morphology of *Coleodesmium wrangelii* (Ag.) Borzi and *Coleodesmiumopsis freyfi* gen. et sp. nov. collected from 3000 m in Singalila Range along Eastern Himalayas under saxicolous habitat in the Botanical expedition in May 1974. Critical comparative study and taxonomy of the alga have been described at the end.

RÉSUMÉ. — La présente étude traite de la morphologie de *Coleodesmium wrangelii* (Ag.) Borzi et de *Coleodesmiumopsis freyfi* gen. et sp. nov., recueillis dans un habitat saxicole, à l'altitude de 3000m dans la chaîne de Singalila de l'Himalaya oriental pendant une Expédition botanique en mai 1974. L'article se termine par une étude comparée et critique de l'algue et de sa taxonomie.

INTRODUCTION

Desmonema wrangelii (Ag.) Bornet et Flahault (1887), the only species of *Desmonema* Berkeley et Thwaites (1849) has been collected from many widely separate places. GEITLER (1932) included two varieties :

1. var. *minor* W. West 1892 where trichome is 5-6 μ m broad . England.
2. var. *major* (Gay 1891) Geitler nov. nom. (1932) where trichome is up to 15 μ m broad . Pyrenean.

The generic name *Desmonema* had been used by two authors separately for Angiosperm i.e. *Desmonema* Rafin (1833) synonymous of *Euphorbia* L. and *Desmonema* Miers (1867) synonymous of *Hyalosepalum* Troupin of *Menispermaceae* (in WILLIS, SHAW et AIRY, 1880). The authors opined that taxono-

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mically it is highly illogical and erroneous to accept the same generic name for Alga and Angiosperm and for this reason endorsing GEITLER (1942) the oldest synonym *Coleodesmium* Borzi (1879) has been accepted for the alga *Desmonema* Berkeley et Thwaites (1849). Thus the valid name of *Desmonema wrangelii* (Ag.) Born et Flah. is *Coleodesmium wrangelii* (Ag.) Borzi.

In this alga there are many parallel pseudobranchings within a common sheath, heterocysts are present in the basal part of the trichomes with appreciable apical attenuation of trichomes; akinetes or spores develop singly or in short series. It grows as an expanded stratum with penicilliform tufts.

MATERIAL AND METHOD

The present form was collected from 3000 m in Singalila Range along Eastern Himalayas during our second expedition in May 1974, as a blackish penicilliform expanded stratum under saxicolous habitat. The day was dark, rainy, cloudy and foggy and the temperature was 12°-15°C. The material thus collected was examined and studied critically under different magnifications.

OBSERVATION

Thallus free, isolated, penicilliform, few mm long, 9.22µm broad richly pseudobranching, pseudobranches two to three within a common sheath initially and later on with individual sheaths, heavily adpressed with each other (Fig. 1A); sheath 1.6µm broad, with faint parallel striations, translucent, pale yellowish to pale brownish, tubular, extending apically (Fig. 2G, sh) and opening by a pore 7.10µm in diameter and giving vent to homogone, hormospore, spore and gonidia (Fig. 3H, h; 4C, g; F, hs; H, s, h) or remaining closed temporarily, trichomes 2.12µm broad, olivaceous or pale green, cells 2.9µm x 2.12µm, apical cells 2.6µm x 1.5-7µm, obtusiform in newly formed branches or conical which later becomes obtusiform, contents richly granular.

During branch formation a vegetative cell, few cells below the apical region of the original trichome divides diagonally into two cells c' and c'' (Fig. 2A, B, C, c' and c''), sheath extends inwardly in between these and forms an oblique plate (Fig. 2F, op) separating two regions - an upper and lower. The upper region continues its growth as a branch, its tubular sheath grows faster (Fig. 2G, sh). The fate of cell c'' is highly peculiar. The trichome at the beginning remains attached with prominent protoplasmic connections (Fig. 3D, F, G, pc) with this cell, which may convert into a single pored heterocyst, oval 8-11µm x 5-10µm or spherical 7-11µm in diameter (Fig. 1A, 3D, 3E, 3F, hc) but gradually the trichome separates breaking the strands (Fig. 3G) and wriggles within the tubular sheath, either liberates as such as a homogone 14-88µm x 5-10µm (Fig. 1D, 3H, 4H, h) through the apical pore of the tubular sheath or develops lone terminal (Fig. 4F, hs) or few hormospores (Fig. 4B, G, hs), 18-30µm x 6-13µm in series separated by biconcave discs (Fig. 4B, G, bd) of shining sub-

stances, $1.4\mu\text{m} \times 5.9\mu\text{m}$ or the terminal cell of the trichome converts into oval gonidium $8.10\mu\text{m} \times 6.7\mu\text{m}$ or spherical ones $8.9\mu\text{m}$ in diameter (Fig. 4A, D, E, g) and liberates apically with some mucilagenous secretion (Fig. 4c, g).

The other role of cell *c'* is, it finally rests in a conical mucilagenous cushion (Fig. 2D, 3A *c'*, *mc*); either remains as rounded or oval cell $5.5\text{--}11\mu\text{m}$ in diameter or converts itself into gonidium, $8\text{--}10\mu\text{m}$ in diameter (Fig. 3B, g) or spore $9\text{--}10\mu\text{m}$ in diameter (Fig. 1A, sp) or gradually degenerates (Fig. 3C, dc). Sometimes intercalary lone or few cells separate out from the trichome and transform into rounded gonidia $5\text{--}8\mu\text{m}$ in diameter, (Fig. 4I, g) or spores $8\text{--}10\mu\text{m}$ in diameter (Fig. 4H, s). In addition to curious reproductive phases the apical part of the trichome may grow vigorously parallel to the lower part and develops similar heavily adpressed pseudobranchings in an alternate sequence all around.

The lower portion with its sheath grows parallelly fully adpressed with the upper part; cell *c'* acts as the apical cell, remains conical initially (Fig. 2B, *c'*) adding new cells to the trichome and finally becomes obtusifrom. The trichome elongates vigorously and repeats the same sequence and at this time oblique division takes place in the direction reverse to the previous one and thus branching are formed in an alternate fashion all around although branchings on the same side are not uncommon. Similar types of reproductive phases as mentioned previously are also common in this lower part. Sometimes there is no oblique plate formation after the oblique division of the vegetative cell and the upper and lower parts of the trichome run parallelly within the common sheath (Fig. 2G).

Attenuation of trichome is prominent during early stages in the development of branching on the upper portion of the lower half and the lower portion of the upper half. This may be retained sometimes or specially the apical part of the upper half may broaden in some cases or there is no prominent apical attenuation, instead of that there is a tendency of slight apical broadening in some of the branches.

In some cases branching in quick succession at short intervals at the apical region results in the formation of several short juvenile branches within a common sheath (Fig. 1C, *jb*).

Sometimes the main trichome breaks up and the basal cell of the upper half of the trichome i.e. *c''* detaches forming gonidium (Fig. 2E, g) or heterocyst (Fig. 4J, *hc*) even before the proper differentiation of a pseudobranch by the activity of the apical cell.

In rare occasion the apex of the lower part of the trichome of newly formed branch pierces through the main sheath and forms a short non adpressed pseudobranch (Fig. 1B, *fb*), while the upper part of the trichome liberates as a hormone leaving the empty sheath behind (Fig. 1B, *es*).

RESULT AND DISCUSSION

After critical and careful comparative study of *Coleodesmium wrangelii*

(Ag.) Borzi with the present alga, the authors noted the following major differences :

1. Unlike *Coleodesmium wrangelii* there are few (2-3) parallel pseudobran- chings within a common sheath initially, but later on in most cases the bran- chings form individual sheaths heavily adpressed with each other.

2. The alternately parallel adpressed pseudobranings with tubular sheaths are sporangial in function and liberate hormogones, hormospores, spores or gonidia after apical dehiscence of the tubular sheaths and formation of a charac- teristic pore or opening.

3. The basal cell and its transformation into single pored heterocyst, spore gonidium or degeneration is highly curious and noteworthy.

4. Attenuation of trichome is prominent during early stages in the develop- ment of branchings on the upper portion of the lower half and the lower portion of the upper half of the trichome. This attenuation may retain sometimes or specially the apical part of the upper half may broaden in some cases or there is no prominent apical attenuation instead there is a tendency of apical broad- ening in some of the branches. Considering these differences in the major characters the authors conclude the present alga a new genus and named it as *Coleodesmiumopsis* gen. nov. and named the type species as *Coleodesmiu- mopsis fremyi* gen. et sp. nov., the specific epithet after celebrated algologist Prof. P. FRÉMY. They further opined that this new alga is phylogenetically close to *Coleodesmium* (Ag.) Borzi of *Scytonemataceae*.

KEY TO THE GENERA

Two to eight parallel pseudobranings within a common sheath, with apical attenuation of trichome and basal heterocyst *Coleodesmium*

Two to three parallel pseudobranings within a common sheath initially but later on with individual tubular sheaths heavily adpressed with each other, attenuation of trichome prominent during early stages in the development of branchings in the upper portion of the lower half and lower portion of the upper half of the trichome, but later on apical broadening of the upper half, conversion of basal cell of newly formed branches into heterocyst, spore, gonidium or ultimate degeneration *Coleodesmiumopsis*

DIAGNOSIS

Thallus free, isolated, penicilliform few mm long 9-22 μ m broad, all around alternately pseudobranched, 2-3 pseudobranches within a common tubular sheath and later with individual sheaths heavily adpressed with each other, sheaths faint parallelly striated, translucent, pale yellowish to pale brownish 1-6 μ m thick extends apically and open by a pore giving vent to hormogones 14-88 μ m x 5-10 μ m, hormospores 18-30 μ m x 6-13 μ m, spores 8-10 μ m or gonidia

5-10 μ m, or remains closed temporarily trichomes olivaceous or pale green, cells 2.9 μ m x 2-12 μ m, apical cells 2.6 μ m x 1.5-7 μ m, obtusiform in newly formed branches or conical which later becoming obtusiform, contents richly granular, basal cell of newly formed branchings 5.5-11 μ m either converting into single pored rounded 7-11 μ m or oval 8-11 μ m x 5-10 μ m heterocysts or spores 9-10 μ m or gonidia 8-10 μ m or degenerating, intercalary gonidia and spore also common, attenuation of trichome prominent during early developmental stages of branchings on the upper portion of lower half and the lower portion of upper half which may retain sometime or specially the apex of the upper part may broaden in some cases or no apical attenuation and a tendency of apical broadening in some of the branchings.

The alga was collected from 3000 m in Singalila Range along Eastern Himalayas under saxicolous habitat during our second Expedition in May 1974, preserved and kept in the research laboratory of Department of Botany, Raj College Burdwan, West Bengal, India under «High Altitude Cyanophyta S.R. (1974) 4(D)» and named as *Coleomiumopsis fremyi* gen. et sp. nov. specific epithet after celebrated algologist Prof. Dr. P. Frémy.

Thallus liber, isolatus, penicilliformis, paucus mm longus, 9-22 μ m latus, alternatim pseudoramosus, 2-3 pseudorami inclusi intra vaginam communem tubularem; vaginae individuae inter se valde adpressae, vaginae dilatae paralleliter striatae, translucens, pallide flavidae ad pallide subfuscae, 1-6 μ m crassae, apice crescentes, poro apertae, hormogonia prodientia per poros, hormogonia 14-88 μ m x 5-10 μ m, hormosporae 18-30 μ m x 6-13 μ m, sporae 8-10 μ m, gonidia 5-10 μ m vel temporaliter inapertae tomentanes. Trichomata olivacea vel dilute viridia, cellulae 2-9 μ m x 1-12 μ m, cellulae apicales 2-6 μ m x 1.5-7 μ m, obtusae in ramis novis vel conicae deinde obtusae, granulares, cellulae basales ramorum novorum 5.5-11 μ m, conversae in heterocystas monosporas rotundatas 7-11 μ m, vel ovaes 8-11 μ m x 5-10 μ m, vel in sporas 9-10 μ m vel gonidia 8-10 μ m vel putrefactae; gonidia intercalaria, sporaque intercalares plerumque visae; trichoma attenuata in ramis juvenibus in parte superiore dimidii inferioris et in parte inferiore dimidii superioris, pars apicalis dimidii superioris interdum dilatata, interdum rami apice non attenuati sed dilatati.

Typus et Etymologia : In mense Maio 1974, in orientali Himalaya altitudine 3,000 metri in Singalila Range, saxilogo habitatu, occasione Expeditionis Botanicae, alga inventa et collecta est alga *Coleodesmiumopsis fremyi* gen. et sp. nov. secundum nomen Prof. Dr. P. Frémy.

Asservatur in Botanico Laboratorio, Raj College, Burdwan, West Bengal, India, in collectione «High Altitude Cyanophyta», sub numero S.R. (1974) 4(D).

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LÉGENDES DES FIGURES

- Fig. 1: *Coleodasmiomopsis fremyii* gen. et sp. nov. — A. general habit. B. Apex of the lower part of trichome forming a short non adressed pseudobranch. C. Several juvenile branchings. D. Liberation of hormogone.
- Fig. 2 : *C. fremyii*. — A, B, C : Stages of the formation of cell c' and c'' during diagonal division of a cell of trichome. D. Resting position of cell c'' in mucilagenous cushion. E. Detached cell c'' forming gonidium. F. oblique plate formation. G. Filament with upper and lower portion of the trichome after oblique division and with apically extended sheath.
- Fig. 3 : *C. fremyii*. — A. Resting of cell c'' in mucilagenous cushion. B. Conversion of cell c'' into gonidium. C. Degenerating basal cell c''. D & E. Conversion of cell c'' into single pored heterocyst. F. Attachment of cell c'' with the trichome by protoplasmic connection. G. Detachment of cell c'' from the trichome. H. Liberation as hormogone of the trichome detached from cell c''.
- Fig. 4 : *C. fremyii*. — A & D. Formation of apical gonidium. B. Formation of hormospores. C. Liberation of gonidium. E. Initiation of gonidium formation from apical cell. F. Liberation of hormospore. G. Series of hormospores. H. Formation of spores and hormogone. I. Series of intercalary gonidia. J. Separation of cell c'' as heterocyst before the differentiation of the branching.

(bd: biconcave disc; c' and c'': cells formed after oblique division of a cell of a trichome during branch formation; dc: degenerating cell; es: empty sheath; fb: non adressed pseudo-branch; g: gonidium; h: hormogone; he: heterocyst; hs: hormospore; mc: mucilagenous cushion; op: oblique plate; pc: protoplasmic connection; sh sheath.

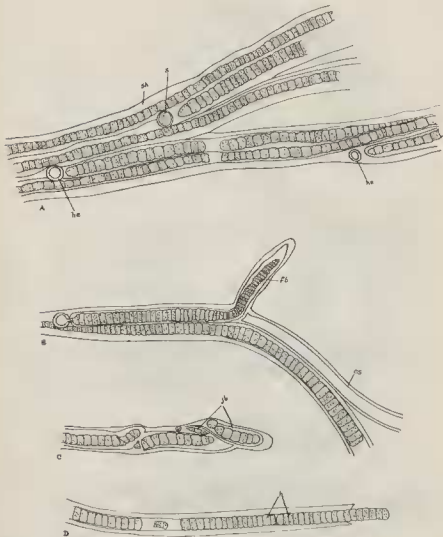


Figure 1

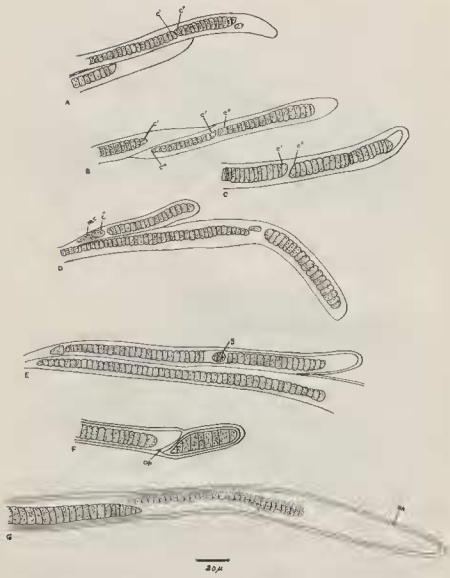


Figure 2

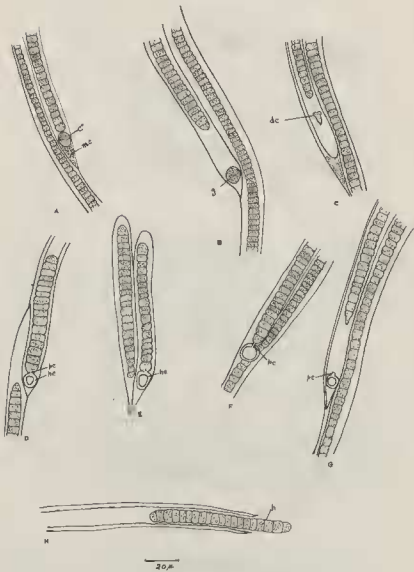


Figure 3

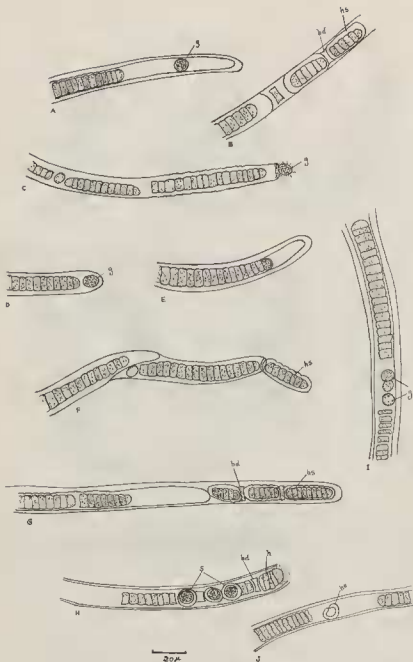


Figure 4